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Cohen

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[54] **LOW WEIGHT FAN WITH INTERNAL COOLING**

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[52] **U.S. Cl.** **417/354**; 417/366; 417/423.15; 417/423.12; 310/62; 415/182.1

[58] **Field of Search** ..... 417/353, 366, 423.8, 417/423.14, 368, 369, 423.15, 423.12, 371, 423.1, 423.2, 423.7; 310/62; 415/182.1, 175, 176, 177, 211.2, 146; 416/204 R

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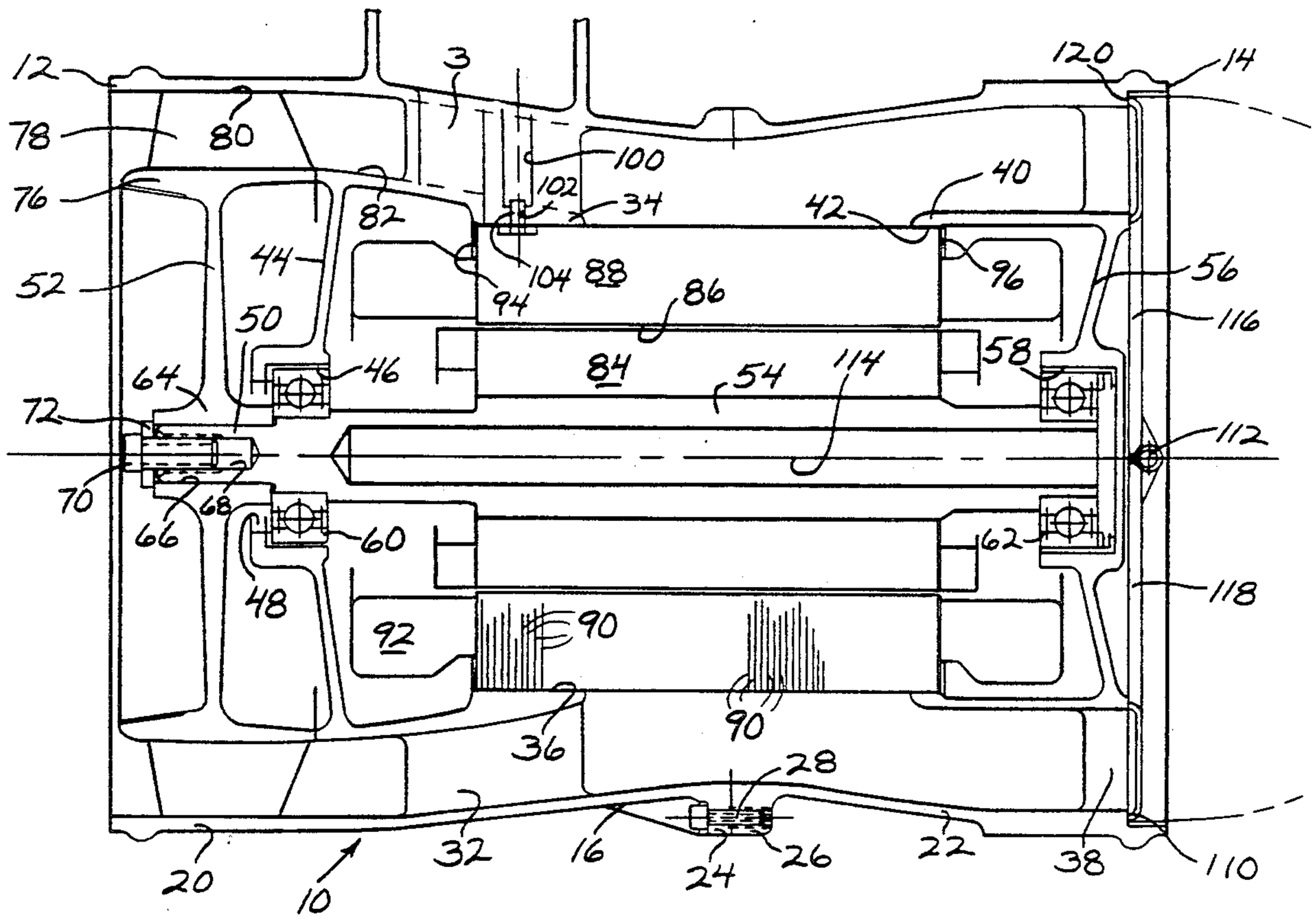
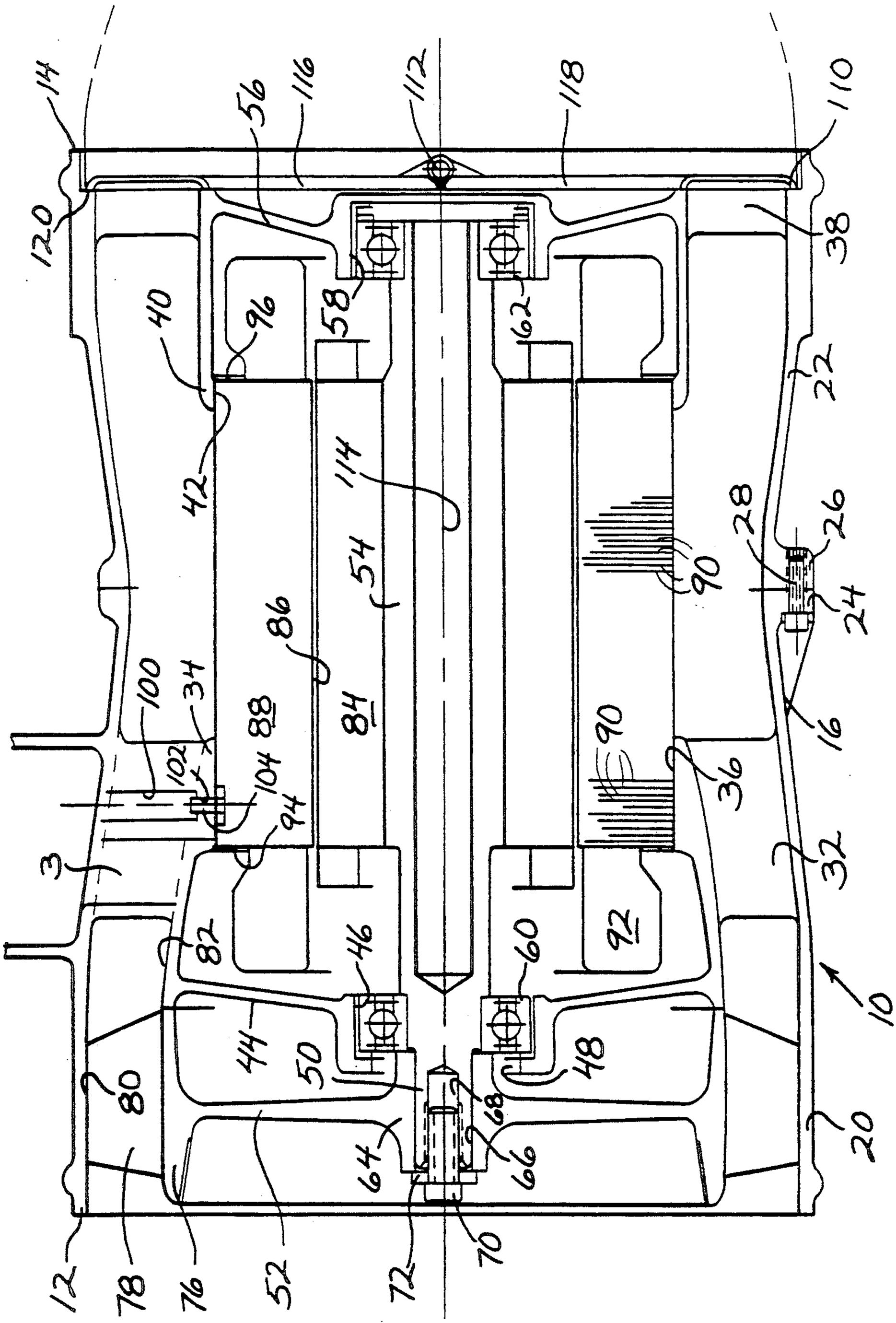
[57] **ABSTRACT**

Electric motor cooling difficulties in a ducted axial flow electric fan construction are avoided through the use of a duct-like housing (**10**) having an interior wall (**30**) with axially spaced feet (**34**), (**40**) within the housing (**10**) and radially inward of the interior wall (**30**). A motor stator (**88**) is located within the housing (**10**) and is engaged by the feet (**34**) and (**40**) to be mounted in spaced relation to the interior wall (**30**) with its exterior surface (**98**) between the feet (**34**), (**40**) and facing and exposed to the interior wall (**30**). A rotor (**84**) is journalled within the stator (**88**) and mounts an impeller (**52**) which drives ambient gas through the housing (**10**) in contact with the exterior surface (**98**) of the stator to cool the same.

6 Claims, 1 Drawing Sheet

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LOW WEIGHT FAN WITH INTERNAL COOLING

FIELD OF THE INVENTION

This invention relates to electric fan constructions, and more particularly, two electric fan constructions having duct-like housing.

BACKGROUND OF THE INVENTION

Electrically driven fans have been utilized extensively virtually since the invention of the electric motor itself. There are a large variety of types including radial flow fans, axial flow fans, centrifugal fans and the like. Each type of fan has various subtypes.

For example, axial flow fans may be generally categorized as being either ducted or unducted. An example of an unducted, axial flow fan is a common household cooling fan.

Ducted axial flow fans are provided with some sort of duct or housing that fits about the impeller closely adjacent the tips thereof so as to confine the air flow. Not untypically, in order to avoid complex gearing or the like, the impellers are mounted directly on the rotor shaft of an electrical motor in such ducted constructions which in turn means that the electric motor must be at least aligned with or even located internally of the ducting. Mounting of the motor may then become a problem as may the cooling thereof. The present invention is directed to overcoming one or more of the above problems.

SUMMARY OF THE INVENTION

It is the principal object of the invention to provide a new and improved electric fan, generally of the ducted, axial flow type. More specifically, it is an object of the invention to provide such a fan wherein the motor is easily and simply mounted and wherein adequate cooling of the motor is readily achieved.

An exemplary embodiment of the invention achieves the foregoing objects in an electric fan construction including a duct-like housing having an internal wall. Axially spaced first and second feet are located within the housing and radially inward of the interior wall. A motor stator is received within the housing and is engaged by the feet to be mounted in spaced relation to the interior wall. The stator has an exterior surface between the feet which is facing and exposed to the interior wall. A rotor is journalled for rotation about an axis within the stator and an impeller is mounted on the rotor and located within the housing and is operative upon rotation of the rotor to cause the ambient gas to pass through the space between the interior wall and the stator to contact the stator exterior surface in heat transfer relation therewith.

The use of the feet to mount the motor stator provides a simplified mounting scheme and which allows the exterior surface of the stator to be exposed to the path of gas through the duct-like housing to be cooled thereby.

In a preferred embodiment of the invention, the housing is formed of two sections with the first foot being in one section and the second foot being in the other section.

Preferably, the stator has opposed ends and the feet engage the stator at corresponding ends.

In one embodiment of the invention, the feet engage the exterior surface of the stator adjacent the opposed ends. In a highly preferred embodiment, the feet are defined by generally ring-like or cylindrical surfaces. The invention contemplates that the interior wall of the duct-like housing mount inwardly directed struts and that the feet be carried by corresponding ones of the struts.

In a highly preferred embodiment of the invention, the struts also include bearing mounting webs and bearings are mounted on such webs. The rotor is then journalled in such bearings. The invention also contemplates the provision of a pivot at one end of the housing and a valve seat generally aligned therewith. A valve member is mounted to the assembly by the pivot and is movable toward or away from the seat.

In a highly preferred embodiment, the pivot is located centrally of the valve seat and two valve members are pivoted thereto, one on each side of the pivot.

The invention also contemplates that the two part housing have a reduced diameter section intermediate its ends and that the two parts be defined by a circumferential split in the reduced diameter section. Fasteners to secure the two parts together are located on the exterior of the housing at the reduced diameter section and within the envelope defined by the ends of the housing to provide a compact structure.

Other objects and advantages will become apparent from the following specification taken in connection with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

The figure is a sectional view of an electric fan made according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

An exemplary embodiment of an electric fan of a ducted, axial flow-type made according to the invention is illustrated in the drawing and with reference thereto is seen to include a housing, generally designated **10**. The housing **10** includes opposed ends **12** and **14**, both of which are open. The housing **10** has a generally circular cross section and intermediate the ends **12** and **14** is a reduced diameter section **16**. At the reduced diameter section **16**, there is a circumferential split **18** which divides the housing **10** into two parts **20** and **22**.

Interengaging flanges **24** and **26** are located on respective sides of the split **18** on the housing parts **20** and **22** respectively.

At circumferentially spaced locations, only one of which is shown, threaded fasteners **28** secure the housing parts **20** and **22** together by interconnecting the flanges **24** and **26**.

The housing **10** includes an interior surface **30** and the part **20** includes three or more radially inwardly extending struts **32**. The struts, at a location inwardly of the interior wall **30** include a mounting foot **34** which is generally ring-like and has a cylindrical inner surface **36**.

The housing part **22** also includes radially inwardly directed struts **38**. The struts **38** also support within the interior of the housing **10** a mounting foot **40** which is ring-like and which has a cylindrical inner surface **42**. It will be noted that the mounting feet **34** and **40** are axially spaced from one another within the housing.

Returning to the struts **30**, the same also mount an inperforate web **44** which extends across the housing part **40** somewhat closer to the end **12** than to the circumferential split **18**, and which include a bearing

mounting recess **46** on one side thereof. Centrally of the web **44** is an opening **48** through which a stubshaft **50** extends to mount an impeller **52** within the end **12** of the housing part **20**. The stubshaft **50** is part of a rotor shaft **54** as will be described in greater detail hereinafter.

The struts **38** likewise mount an imperforate web **56** which includes a bearing recess **58** facing the bearing recess **56**. The web **56**, however, lacks any opening corresponding to the opening **48**, having an imperforate center **59**.

Bearings **60** and **62** are received in the recesses **46** and **58** respectively and journal the rotor shaft **54** for rotation within the housing **10**.

The impeller **52** includes a hub **64** which in turn is provided with a smooth interior bore **66** which receives the stub shaft **50**, the latter also having a smooth exterior surface. That is to say, the interface of the hub **64** and the stub shaft **50** is smooth and free of keyways or the like. The stub shaft **50** includes an internal threaded bore **68** which receives a threaded fastener **70** whose head bears against a washer **72** which in turn engages the hub **64** to compressingly clamp the same against the inner race of the bearing **46**. It will be observed that the components are sized so that the washer **72** does not engage the end of the stub shaft **50** so that the aforementioned compressive connection exits.

The impeller **52** terminates in a circumferential ring **76** mounting radially extending impeller vanes **78** which in turn terminate at ends **80** closely adjacent the inner wall **30** of the housing **10** and which may be of conventional form.

It will be observed that the ring **76** is aerodynamically contoured and is aligned with a smooth, generally cylindrical surface **82** which merges with the ring or foot **34** to minimize resistance to flow of ambient gas through the housing **10**.

The shaft **54** supports a conventional electric motor rotor **84** within the central opening **86** of a stator **88**. As can be seen, the stator **88** is made up of a stack of ferrous laminations **90** in a conventional fashion and includes windings, only the end turns **92** of which are shown. The stator **88** has opposite ends **94** and **96** which are received within the cylindrical openings **36** and **42** of the mounting feet **34** and **40**. That is to say, the end most laminations **90** within the stack making up the stator iron are received within the feet **34** and **40**, leaving the central outer surface **98** of the laminations **90** thereat exposed to and facing the interior surface **30** of the housing and in spaced relation thereto.

This, of course, occurs in the region of the reduced diameter section **16**. The arrangement is such that from one end of the housing **10** to the other, the cross sectional area of the flow path through the housing remains constant even though the inner and outer diameter of such flow path changes. This is to assure that no undue resistance to the flow of gas occurs in the reduced diameter section **16**.

The presence of the reduced diameter section **16** also enhances heat transfer. As will be readily apparent from the drawing, the air is moving axially, as well as radially inward, and thus will impinge to some degree on the central outer surface **98** of the laminations **90** to provide impingement cooling as well as conductive cooling. Heat transfer efficiency is thus enhanced by the presence of the reduced diameter section **16**.

Desirably, one of the struts **32** may include a radial bore **100** terminating in a tapped, reduced diameter section **102** for receipt of a set screw **104** or the like in engagement with the stator **88** to prevent the same from moving within the mounting feet **34** and **40**.

The housing part **22**, and specifically, the end **14** therein includes concentric valve seats **110** and **111**. In general alignment therewith, a pivot pin **112** extends across the end **14** to be mounted to the imperforate center **59** of the web **56** by any suitable means. That is to say, the pivot pin **112** is located centrally of the valve seats **110** and **111** and generally intersects the rotational axis **114** of the rotor **84**.

First and second valve flaps **116** and **118** configured as half donuts are pivoted to the pivot pin **112** and include peripheral surfaces **120** and **121** configured to seat against the valve seats **110** and **111**, respectively. The valve flaps **116** and **118** are shown in a closed position and a light spring (not shown) may be utilized to normally bias the valve flaps **116** and **118** to that position to provide a check valve action.

In operation, the impeller **52** will drive ambient gas as, for example, air into the housing **10** through the end **12** and drive it against the valve flaps **116** and **118** which will then open and allow the gas to be expelled through the end **14**. In the process, the air will pass in direct heat exchange relation or contact with the outer surface **98** of the stator **88** to provide excellent cooling of the same.

It will also be appreciated that the use of the reduced diameter section **16** intermediate the ends **12** and **14** allows the housing parts **20** and **22** to be secured together by exterior fasteners without increasing the outer envelope of the overall structure. That is to say, the fasteners **28** are all located within the envelope defined by the ends **12** and **14**.

The use of two housing parts **20** and **22** having a central circumferential split **18** allows easy assembly of the motor within the housing sections. Furthermore, it allows the housing **10** to be made up of two components to reduce the complexity of the castings required to form the housing.

The invention also allows a check valve function to be incorporated within the housing itself for compactness.

Significantly, a substantial weight reduction is achieved along with improved cooling by the elimination of any means on the electric motor part of the construction radially outward of the stator exterior surface **98**, that is, by not providing a separate housing for the motor stator itself.

It will also be appreciated that this excellent cooling is achieved even though the motor itself is essentially sealed within the flow path for the gas save for the opening **48** within the web **44**; but because the web **56** is completely imperforate, no pressure differential will exist that would allow the flow of gas into the motor through the opening **48** which could bring contaminants into its inner workings.

I claim:

1. An electric fan comprising:

an elongated duct-like housing having a generally circular cross section, opposed open ends, and a circumferential split between said ends dividing the housing into two parts;

means securing said parts together;

each of said parts having an internal ring of reduced diameter and inwardly directed, circumferentially spaced struts mounting the rings in aligned but axially spaced relation;

an electric motor stator located in said housing with its ends in corresponding ones of said rings;

bearing mounting webs on said struts;
bearings carried by said webs;
a rotor journalled in said stator by said bearings; and
an impeller within said housing at one end thereof and secured to said rotor for rotation therewith.

2. The electric fan of claim **1** further including a pivot in said housing at the end opposite said impeller; a valve seat within said housing and aligned with said pivot; and at least one valve member mounted to said housing by said pivot and movable toward and away from said seat.

3. The electric fan of claim **2** wherein said pivot is located centrally of said valve seat and mounts two valve member, one on each side of said pivot.

4. An electric fan comprising:
an elongated duct-like housing having a generally circular cross section, opposed open ends, an intermediate reduced diameter section and a circumferential split in said reduced diameter section dividing the housing into two parts;
fasteners on the exterior of said housing at said reduced diameter section and generally within the envelope defined by said opposed ends and securing said parts together;
each of said parts having an internal ring of lesser diameter than said reduced diameter section and inwardly directed, circumferentially spaced struts mounting the rings in aligned but axially spaced relation;
an electric motor stator including electrical windings, and stacked ferrous laminations with an exterior surface sized to be received within said rings, said stator being located in said housing with end most laminations in said stack being located in corresponding ones of said rings;
bearing mounting webs on said struts;
bearings carried by said webs;
a rotor journalled in said stator by said bearings; and
an impeller within said housing at one end thereof and secured to said rotor for rotation therewith.

5. The electric fan of claim **4** wherein said rotor includes a smooth cylindrical stub shaft at one end and said impeller includes a hub with a smooth base receiving said stub shaft, and a fastener threaded into said stub shaft and compressively loading said hub to secure said impeller to said rotor.

6. An electric fan comprising:
a duct-like housing having an interior wall;
axially spaced first and second feet within said housing and radially inward of said second wall, said feet being defined by generally cylindrical surfaces;
a motor stator within said housing and engaged by said feet to be mounted in spaced relation to said interior wall, said stator having an exterior surface between said feet facing and exposed to said interior wall;
a rotor journalled for rotation about an axis within said stator; and
an impeller mounted on said rotor and located within said housing and operative upon rotation of said rotor to cause ambient gas to pass through the space between said interior wall and said stator and to contact said stator exterior surface in heat transfer relation therewith.

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